AKBP 4: Radiation Generation and Applications

Time: Monday 16:00–17:30 Location: AKBP-H14

AKBP 4.1 Mon 16:00 AKBP-H14

Status of Thomson Backscattering Investigation at MESA — •Christoph Lorey[1] and Atoosa Meseck[1,2] — [1]Johannes Gutenberg Universität, Mainz, Germany — [2]Helmholtz Zentrum Berlin, Berlin, Germany

At the Johannes Gutenberg University (JGU) in Mainz, a new accelerator is currently under construction in order to deliver electron beams of up to 155 MeV to two experiments. The Mainz Energy-recovering Superconducting Accelerator (MESA) will offer two modes of operation, one of which is an energy-recovering (ER) mode. As an ERL, MESA, with it's high brightness electron beam, is a promising accelerator for supplying a Thomson back scattering based Gamma source. Furthermore, at MESA, the polarization of the electron beam can be set by the injector. The aim of this work under the GraKo AccelencE is to provide a concept and comprehensive analysis of the merit and practical feasibility of a Thomson backscattering source at MESA under consideration of beam polarization and transversal effects. In this presentation, an overview and first results of our semi analytical approach to calculate various Thomson back scattering light source scenarios at MESA will be given.

AKBP 4.2 Mon 16:15 AKBP-H14

A novel compact x-ray source for microbeam radiation therapy — •Christoph Matejcek[2,4], Johanna Winter[1,2,3], Jan J. Wilkens[2,3], Stefan Bartzsch[1,2], and Kurt Aulenbacher[4,5,6] — [1]Helmholtz Zentrum München GmbH, Neuherberg — [2]Technische Universität München, School of Medicine und Klinikum rechts der Isar, München — [3]Technische Universität München, Physik-Department, Garching — [4]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [5]elmholtz Institut Mainz — [6]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Microbeam radiation therapy is a new preclinical concept in radiation oncology. Due to the use of 25 to 100 um wide and a few 100 um separated planar x-ray beams, high peak dose values are crucial. Additionally, low photon energy of a few 100 keV and high dose rates are demanded to suppress blurring of the dose pattern. To produce such x-rays with a preclinical prototype of a compact microbeam x-ray tube, a new electron source with a fast rotating target for x-ray production is under development. The source will deliver electrons with a kinetic energy of 300 keV and a current of 300 mA on a strongly eccentric 0.05 mm x 30 mm focal spot. Transport of these high currents at low energy will be challenging concerning space charge forces. Furthermore, the realization of the focal spot, a good beam quality, and a low emittance are major topics. An additional application of the x-ray source can be phase contrast imaging. The final design of the x-ray source and the results of the electron tracking simulations will be presented.

AKBP 4.3 Mon 16:30 AKBP-H14

Spectro-temporal properties of CHG radiation — •Arjun Radha Krishnan, Benedikt Büsing, Arne Held, Hubertus Kaiser, Shaukat Khan, Carsten Mai, and Vivek Vijayan — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

The short-pulse facility at the 1.5-GeV synchrotron light source DELTA, operated by the TU Dortmund University, currently employs the Coherent Harmonic Generation (CHG) technique to generate ultrashort coherent radiation pulses in the vacuum ultraviolet spectrum. This is achieved via a laser-induced electron energy modulation and a subsequent dispersive section which converts it to a corresponding density modulation. The spectro-temporal properties of the CHG pulses can be manipulated by the chirp of the seed laser pulses and the strength of the dispersive chicane (R56).

CHG spectra for 400 nm, 266 nm and 200 nm were recorded under variation of R56 and laser chirp of the 800 nm seed laser pulses. The measured spectra and results of numerical simulations to reconstruct the spectra will be presented.

AKBP 4.4 Mon 16:45 AKBP-H14

Utilizing the ELSA accelerator for evaluation of the FLASH effect with ultra-high energy electrons — •Alexandra Wald[1], Manuela Denz[2], Klaus Desch[1], Daniel Elsner[1], Stephan Garbe[2], Frank Giordano[2], Carsten Herskind[3], and Dennis Proft[1] — [1]Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn — [2]Universitätsklinikum Bonn — [3]Medizinische Fakultät Mannheim, Universität Heidelberg

At the electron accelerator facility ELSA electrons with a final energy from 0.8GeV up to 3.2GeV can be accelerated and stored. These electrons can be extracted to one of the two detectors for hadron physics experiments as well as to a detector testing site, where the primary electron beam is directly provided for internal and external users.

In cooperation with the University Hospital Bonn (UKB), this test beam line will be used to carry out basic experiments on irradiation of biological cells to evaluate the FLASH-effect using ultra-high energy electron (UHEE) beams. This requires short and intense electron pulses in the order of microseconds to be extracted via a newly designed extraction mode from the storage ring. Furthermore, new diagnostics are planned to be set up to verify the reproducibility of overall charge and position of the electron pulses.

The first steps towards systematic irradiation of cells for measuring the relative biological effectiveness will be presented.

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AKBP 4.5 Mon 17:00 AKBP-H14

Status of the Laser-Compton backscattering Source at the S-DALINAC* — •Maximilian Meier, Michaela Arnold, Joachim Enders, and Norbert Pietralla — Institut für Kernphysik, TU Darmstadt, Germany

Compton scattering of a Laser beam off an ultra-relativistic electron beam ($E_e \gg m_e c^2$) through a restricted aperture can provide quasi-monochromatic highly polarized X-ray or gamma-ray beams for a variety of applications [1]. Highest energies of the scattered photons are obtained for photon-scattering angles of 180°, i. e., backscattering. A powerful stable and well synchronized laser with a high repetition rate is essential for a high-flux Laser-Compton light source with narrow energy-bandwidth. A project at TU Darmstadt foresees to synchronize a highly repetitive high-power laser with the Superconducting DArmstadt electron LINear ACcelerator (S-DALINAC [2]), capable of running in energy recovery mode [3], to realize a Laser-Compton backscattering (LCB) source with photon beam energies up to 180 keV. An overview over the design concept of the LCB Source at the S-DALINAC will be given, simulations on the layout and the estimated output will be presented.

[1] C. Bemporad et al., Phys. Rev. 138, B1546 (1965)
[2] N. Pietralla, Nucl. Phys. News 28(2), 4 (2018)
[3] M. Arnold et al., Phys. Rev. Accel. Beams 23, 020101(2020)

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AKBP 4.6 Mon 17:15 AKBP-H14

Investigation of irradiation damage in Ti6Al4V via high-energy x-ray diffraction — •Tim Lengler[1,4], Dieter Lott[1], Gudrid Moortgat-Pick[2,4], Sabine Riemann[3], Andrey Ushakov[2], Emad Maawad[1], Andreas Stark[1], and Peter Staron[1] — [1]Institute of Material Research, Helmholz-Zentrum Hereon, 21502 Geesthacht, Germany — [2]Deutsches Elektronen-Synchrotron (DESY), 22607 Hamburg, Germany — [3]Deutsches Elektronen-Synchrotron (DESY), 15738 Zeuthen, Germany — [4]Universität Hamburg, 20148 Hamburg, Germany

For the positron source of the International Linear Collider (ILC) the choice of a suitable target material is crucial. The material must resist the high cyclical load, which is induced in the target while creating about 10^{14} positrons per second. One of the most promising targets consists of the titanium alloy Ti6Al4V. For realistic feasibility tests, several thin plates of the alloy were subjected to an intense electron beam at the Mainzer Microtron.

In this work, we report about the investigation of the irradiated material via High Energy X-Ray Diffraction (HEXRD) at the Hereon endstation of the P07 beamline at DESY. Changes in the crystallographic properties and phases due to the treatment were examined since these may compromise the longevity of the material. Additional tests were performed, where the thermal component of the cyclical load was realized in a quenching dilatometer and again examined via HEXRD. The results will be discussed here.